

$$\chi_A = \frac{c_{A_0} - c_A}{c_{A_0}}$$

$$c_A = c_{A_0}(1 - \chi_A)$$

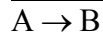
0th Order Irreversible

$$c_A = c_{A_0} - kt$$

$$\chi_A = \frac{kt}{c_{A_0}}$$

valid only when $t < (c_{A_0}/k)$

1st Order Irreversible



$$c_A = c_{A_0}e^{-kt}$$

$$c_B = c_{B_0} + c_{A_0}(1 - e^{-kt})$$

$$\chi_A = 1 - e^{-kt}$$

2nd Order Irreversible – Uni

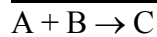


$$c_A = \frac{c_{A_0}}{c_{A_0}kt + 1}$$

$$c_B = c_{B_0} + \frac{c_{A_0}^2 kt}{2(c_{A_0}kt + 1)}$$

$$\chi_A = \frac{c_{A_0}kt}{1 + c_{A_0}kt}$$

2nd Order Irreversible – Bi – Stoich = 1

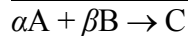


$$c_A = \frac{c_{A_0} - c_{B_0}}{1 - \gamma e^{qt}}$$

$$\chi_A = \frac{\gamma(e^{qt} - 1)}{\gamma e^{qt} - 1}$$

where $q = (c_{B_0} - c_{A_0})k$ and $\gamma = c_{B_0}/c_{A_0} \neq 1$

2nd Order Irreversible – Bi – Stoich $\neq 1$



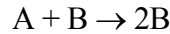
$$c_A = \frac{c_{A_0}(\beta c_{A_0} - \alpha c_{B_0})}{\beta c_{A_0} - \alpha c_{B_0} e^{qt}}$$

$$\chi_A = \frac{\gamma(e^{qt} - 1)}{\gamma e^{qt} - 1}$$

where $q = [c_{B_0} - (\beta/\alpha)c_{A_0}]k$ and $\gamma = \alpha c_{B_0}/\beta c_{A_0} \neq 1$

Important Equations from Chapter 2

Autocatalytic

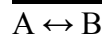


$$c_A = \frac{c_{A_0} + c_{B_0}}{1 + \gamma e^{qt}}$$

$$\chi_A = \frac{\gamma(e^{qt} - 1)}{1 + \gamma e^{qt}}$$

where $q = (c_{B_0} + c_{A_0})k$ and $\gamma = c_{B_0}/c_{A_0}$

1st Order Reversible



$$K_{eq} = \frac{k_1}{k_{-1}} = \frac{c_{B_{eq}}}{c_{A_{eq}}}$$

$$\chi_{A_{eq}} = \frac{(K_{eq} - \gamma)}{(K_{eq} + 1)}$$

$$K_{eq} = \frac{(\gamma + \chi_{A_{eq}})}{(1 - \chi_{A_{eq}})}$$

$$\chi_A = \chi_{A_{eq}}(1 - e^{-qt})$$

where $q = \frac{k_1(\gamma + 1)}{(\gamma + \chi_{A_{eq}})}$ and $\gamma = c_{B_0}/c_{A_0}$

Series First Order Irreversible Reactions



$$c_A = c_{A_0}e^{-k_1t}$$

$$c_B = \frac{k_1 c_{A_0}}{k_2 - k_1} (e^{-k_1t} - e^{-k_2t}) + c_{B_0} e^{-k_2t}$$

$$c_C = c_{C_0} + \frac{c_{A_0}}{k_2 - k_1} (k_1 e^{-k_2t} - k_2 e^{-k_1t}) - \frac{c_{B_0}}{k_2} e^{-k_2t}$$

$$t_{max} = \frac{\ln k_1 - \ln k_2}{k_1 - k_2}$$

Enzyme Kinetics



$$\frac{dc_S}{dt} = \frac{V_{MAX} c_S}{K_M + c_S}$$

$$V_{MAX} t = c_{S_0} - c_S + K_M \ln \left(\frac{c_{S_0}}{c_S} \right)$$

where $V_{MAX} = k_2 c_{E_0}$ and $K_M = (k_{-1} + k_2)/k_1$